ERF Seminar
Lund
October 26, 2008

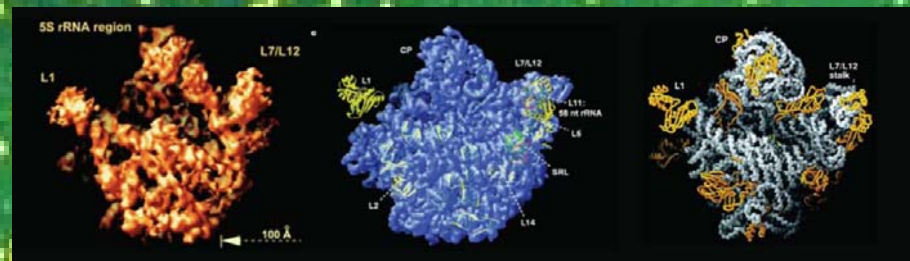
How can Strategic Access to Research Infrastructures Foster Technology Advancement ?

Outcomes from the GENNESYS study

Helmut Dosch.
DESY

Nobel Price Chemistry 2009.

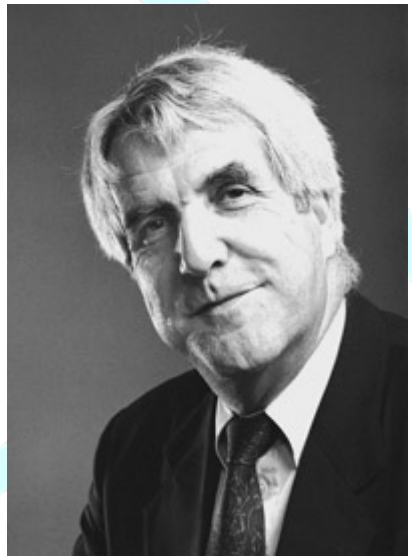
- **Ada Yonath** (together with
- V. Ramakrishnan und T. Steitz)
- Pioneered Ribosome crystallography
- 1986-2004 Head of Max-Planck group „Ribosomstruktur“ at **DESY**
- Key x-ray experiments at **DORIS /BW6**



Ruprecht Haensel

1935 – 2009

Pioneer of Synchrotron radiation



1962 - 1984	Pioneering work at DESY
1985 - 1986	Director General ILL
1986 - 1992	Director General ESRF
1993 - 1996	Dean Physics Faculty U Kiel
1996 - 2000	President U Kiel
19.10.2009	†

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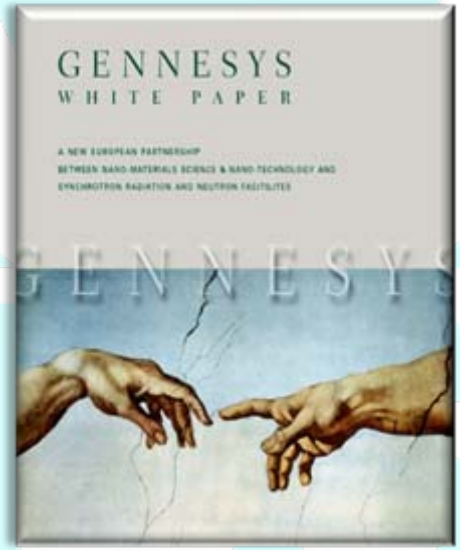
Outcomes from the GENNESYS Study



H. Dosch and M.H. Van de Voorde
Grand European Initiative on Nanoscience and Nanotechnology Exploiting Synchrotron Radiation and Neutron Facilities

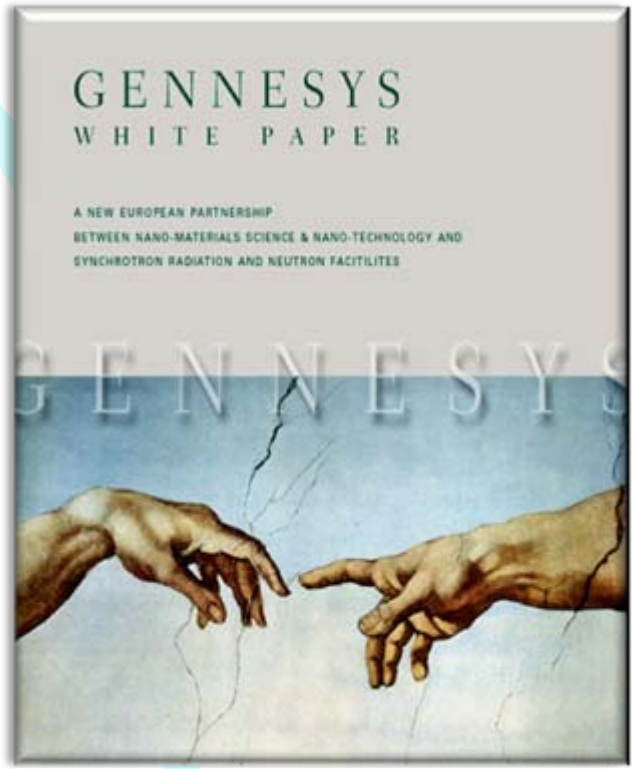
Max-Planck-Institut für Metallforschung, Stuttgart (2009)
ISBN 978-3-00-027338-4

GENNESYS Foresight Study (2003-2008)

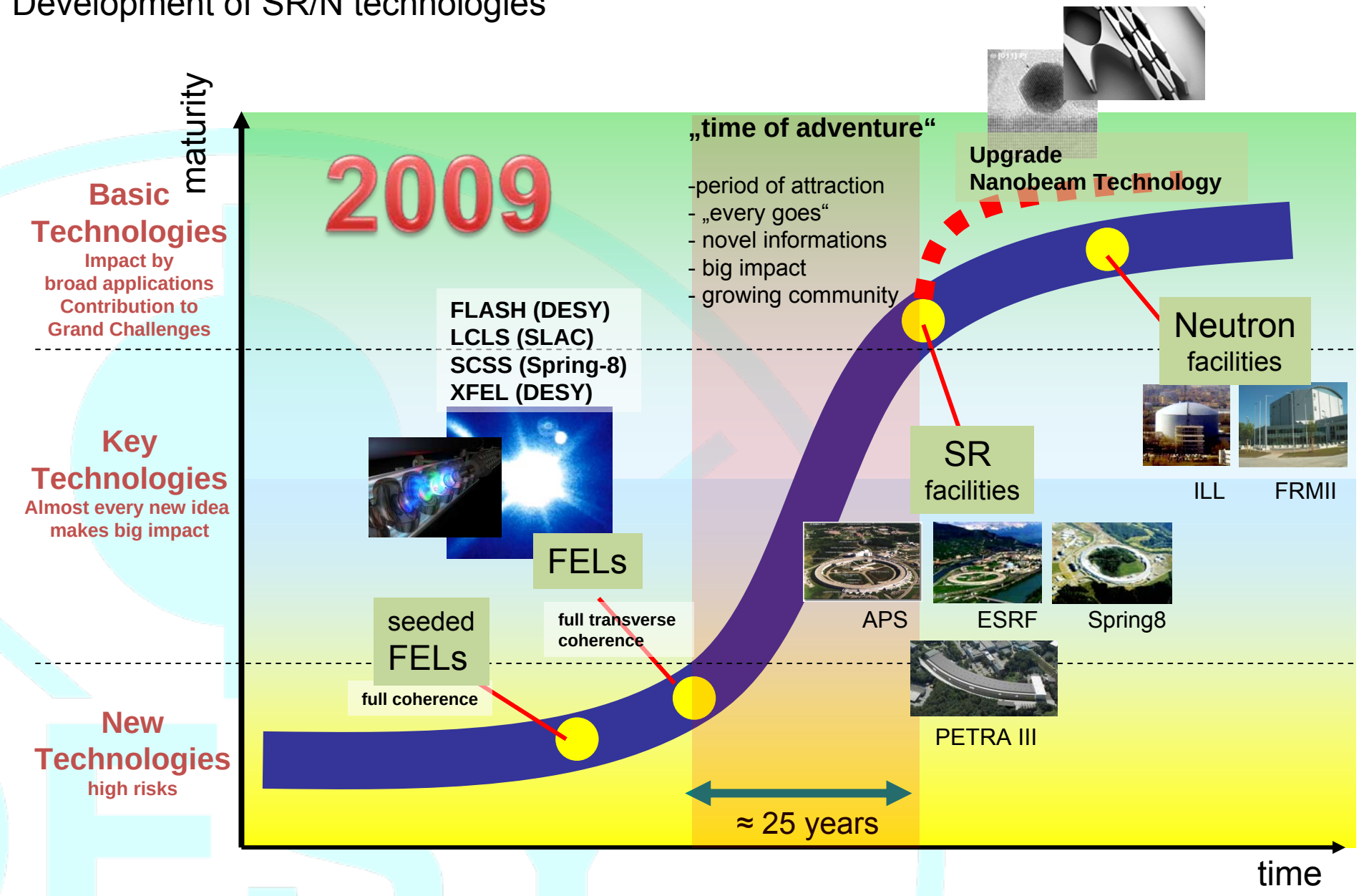
Future Strategic Nanoscience
for Key Technologies in Europe:

-State of the Art
- Future Needs
- Key Barriers
- Role of RIS
- Conclusions/Recommendations

more than 600 authors/contributors from
Universities Research Labs Industry
Large Scale Facilities



Development of SR/N technologies



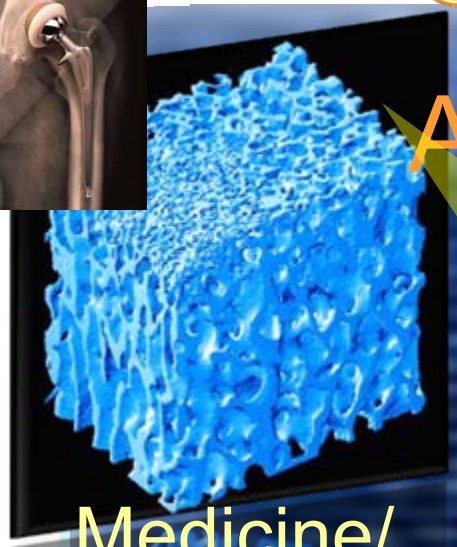
Mature X-facilities

„Synchrotron radiation and more“

New User Communities !!	Nanoscience, Paleontology, Art, Medical, …. „learning from past mistakes“
Dedicated Research Consortia onsite	ESRF: PSB; DESY: CSSB
User Support Facilities	DESY: Nanolab
Involvement of local Universities	**Research and Education**
Industrial Applications	**BMBF 2009: „What is the role of the German photon facilities in the innovation process ?“**
Open Access vs. Strategic Access	Conclusions from GENNESYS study


MONEY
Fundamental Research
Traditional role of SR & N
Innovation Process
New role of SR & N ?
KNOWLEDGE

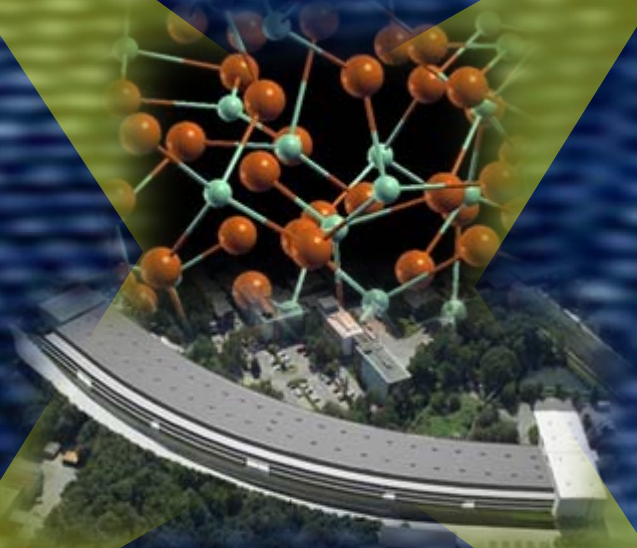
Grand Challenges

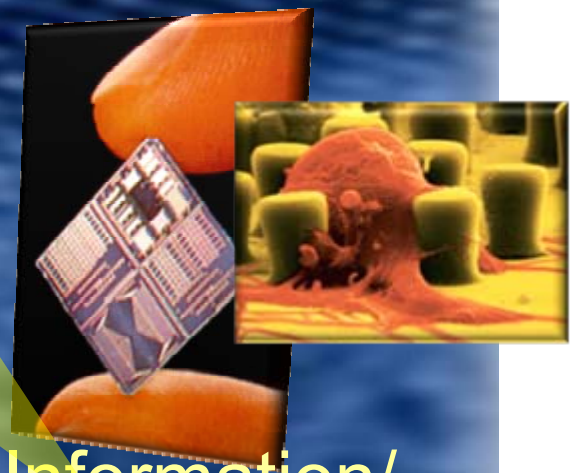


Advanced Materials
for Key Technologies

Energy/
Environment

Medicine/
Health





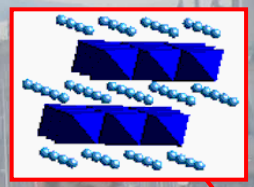
Transport

Advanced
SR Facilities

Information/
Communication

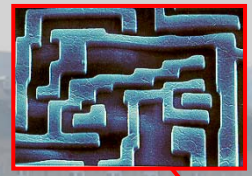

On a typical day in Europe ....

Pace Maker
Li-Batteries
New Materials for Energy



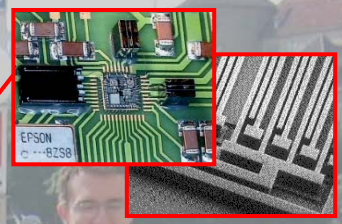
Mobile Phone
SAW Structures

GPS Navigation
Functional Materials



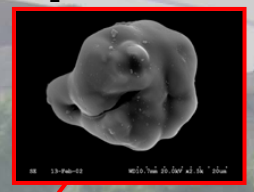
Artificial Hips
Biocompatible
Materials

Air Bag
Accelaration Sensors
MEMS

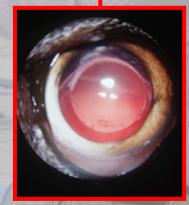


Glasses and Coatings
Optical Materials
UV Filter

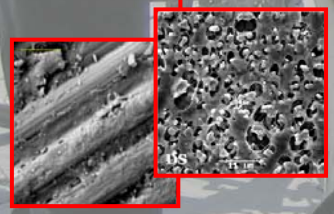
Cosmetics
TiO_2 Nanoparticle



Digital Camera
CCD Chip



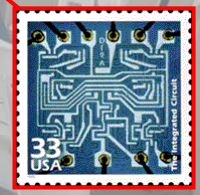
Artificial Lens
Biocompatible
Polymers



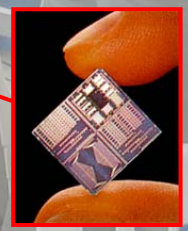
Bike Frame
Carbon Fibres
Composite Materials

GMR Read Head
Magnetic
Multilayers

LED Display
Photonic Materials



Intelligent Credit Card
Integrated Circuits



Exact Time via satellite
Semiconductíng devices
Micro-Batteries

Taylored Materials at Work ….

GENNESYS State of the Art: Nanoscience

Fragmentation of Efforts between

- disciplines, scientific communities, sectors
- funding agencies („vertical structures meet horizontal challenges“)
- members countries

No Clear Research Strategy for Urgent Challenges

- renewable energy, environment, climate change, …

Underusage of European Research Infrastructure „Information Gap“

Insufficient Integration of Eastern European Member States

Inadequate Training Schemes and Unclear Research Careers

Awareness Dilemma : Importance of Materials

and others ……

GENNESYS Roadmaps

Grand Challenges in Nanoscience and Nanotechnology (selection)

Generic Challenges

Nano-Confinement
Proximity
Dimensionality
Interfaces

Hierarchical Structures

Quantum Phenomena

Materials-Specific Challenges

Taylored Design
Screening of Complex Multicomponent Materials
Impurity Control
Hybrid Architectures
Multiferroics
Smart Nanostuctures
Failure-Proof/Self-repairing Systems

Nanomaterials and –systems in extreme conditions
Nanostandards
Nanolubrication
Nanojoining

Technology Challenges

Novel nanomaterials for future -
- climate-friendly energy technologies
- pharmaceuticals, medicine,
- chemical industry, catalysis
- processing industry
- information technologies
- transport technologies
- cultural heritage
- …….

Better understanding of –
- toxic effects
- friction / wear at nanoscale
- corrosion / protection
- ……

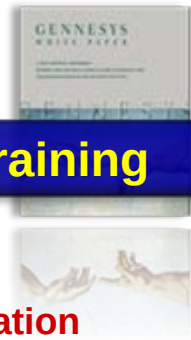
GENNESYS

Universities *Research Labs* *Industry*

Fundamentals **Materials** **Technologies**

Nano-Device

Training



Nanostructures

Dimensionality Effects

Proximity

Interfaces

Nanoconfinement
Quantum Effects

Thin Films Multilayers

Hierarchical Structures

Dynamics

Synthesis

Multiscale Modelling

STRUCTURAL

FUNCTIONAL

BIO

POLYMERS

COATINGS

INORGANICS HYBRIDS

Nanomechanical Engineering

Nanocorrosion Protection

Nanotribology Nano-Joining

INFORMATION COMMUNICATION

HEALTH/MEDICINE

FOOD Cosmetics

TRANSPORT

ENERGY

ENVIRONMENT CLIMATE CHANGE

CHEMICAL INDUSTRY

CATALYTIC PROCESSING

TOXICITY

SECURITY

Monitoring Systematics Discovery

Nano-Standardisation

Quality Assurance

Prenormative Research

Impurities

Nano-Compatibility

Failure Degradation Performance

Extreme Environments

Relevant Conditions

Nondestructive Insitu

Challenges for Synchrotron Radiation and Neutron Facilities

GENNESYS Conclusions/Recommendations

- Create knowledge-based research platforms for nanomaterials design
- Exploit the (already existing) full analytical potential of European RIS
- Build interdisciplinary /intersectorial nanomaterials research consortia
- Engage in a strategic and sustainable European research & training effort
  (with better integration of Eastern European countries)

For urgent and complex problems (energy, environment, IT, medical)

- set up dedicated Science / Technology Centres which
  - overcome fragmentation
  - focus all forces and (expensive) technologies from all disciplines
  - act as a European hubs for research and training
- Place these centres strategically in direct neighbourhood/interaction to/with RIS
  - to enable novel strategic access to (existing) high-tech nano-analysis facilities:
    insitu, in-vivo, systematic investigations, combinatorial studies, direct access
    long-term studies (lt-perfomance, degradation, failure, quality assurance,…), standardization,

Mature X-facilities

„Synchrotron radiation and more“

New User Communities !!	Nanoscience, Paleontology, Art, Medical, …. „learning from past mistakes“
Dedicated Research Consortia onsite	ESRF: PSB; DESY: CSSB
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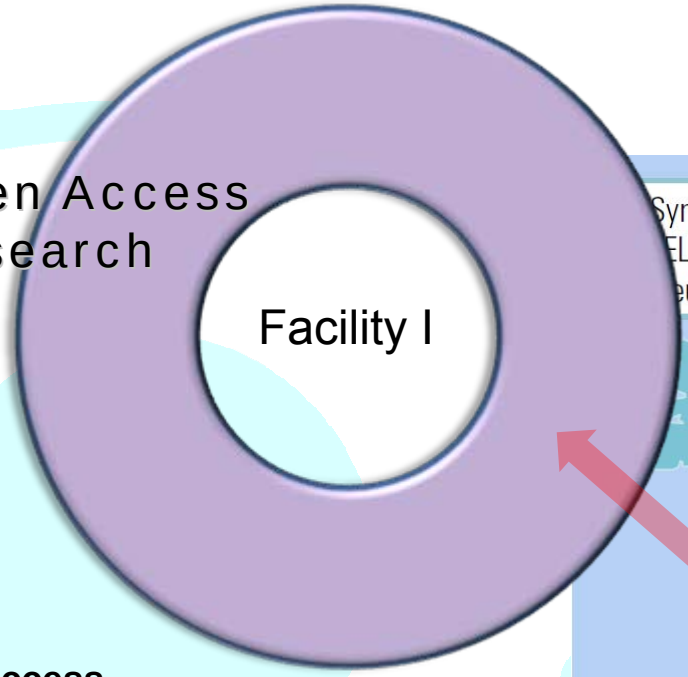
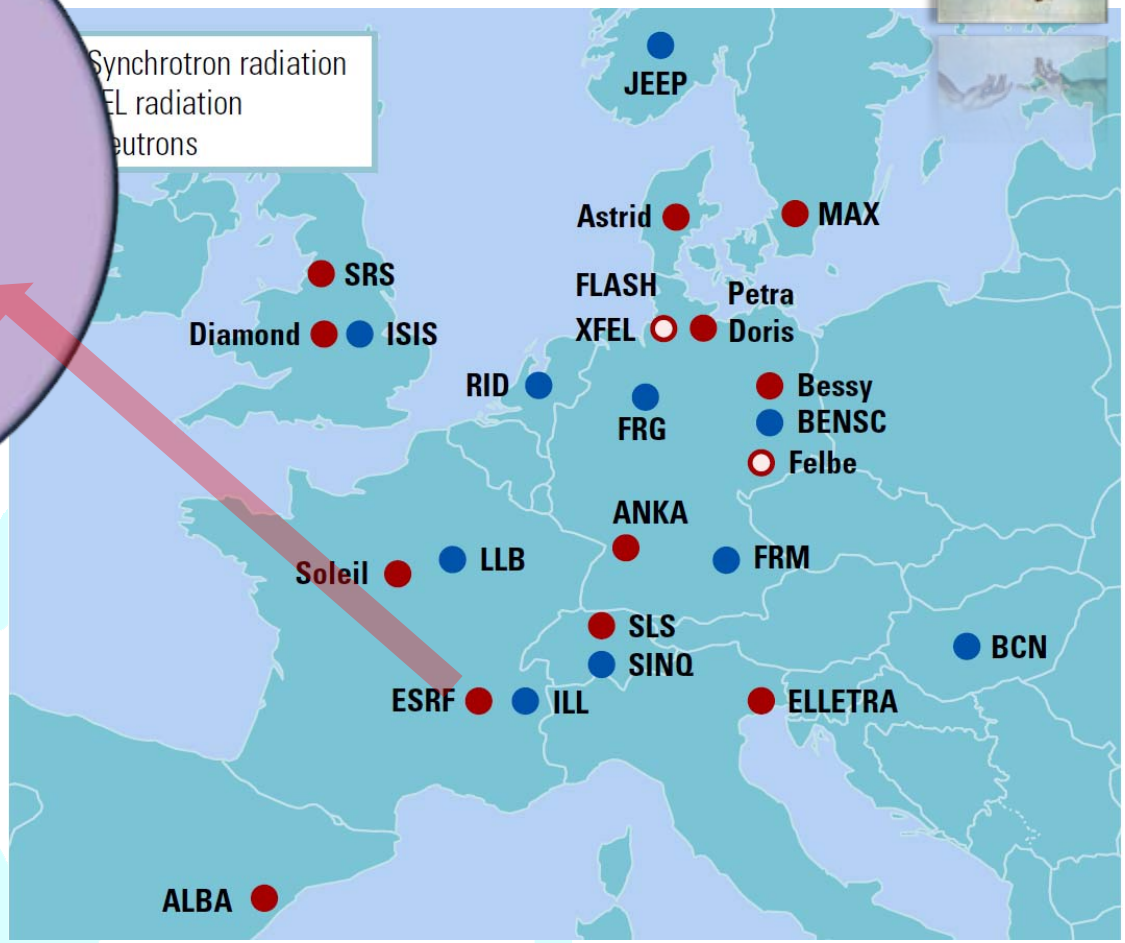
Industrial Applications	**BMBF 2009: „What is the role of the German photon facilities in the innovation process ?“**
Open Access vs. Strategic Access	Conclusions from GENNESYS study

I3

Open Access Research





Open access

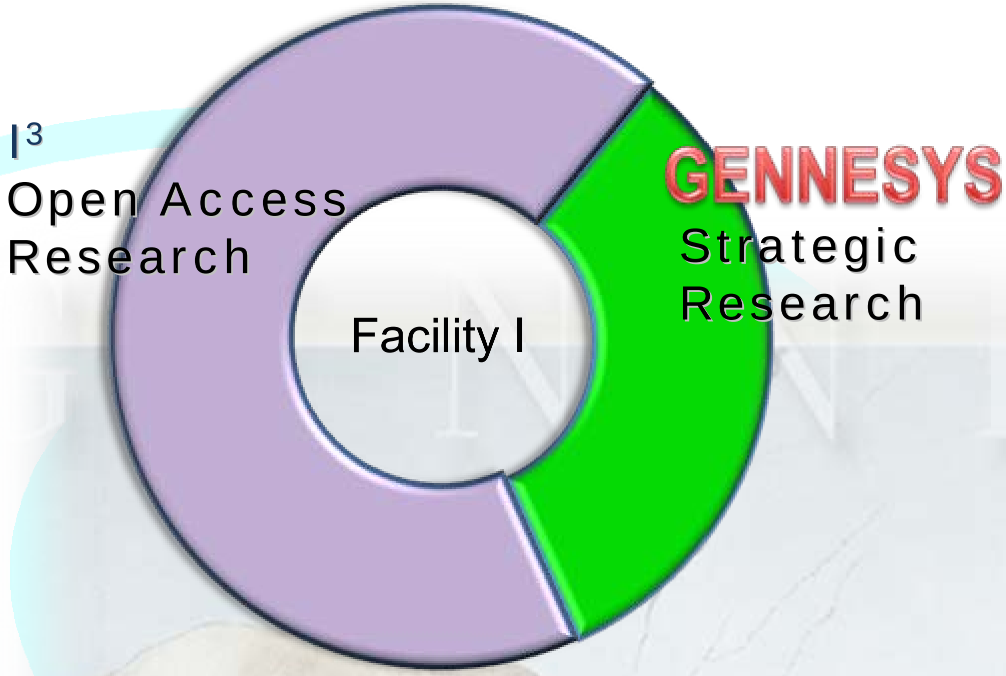
based on scientific excellence

proposal peer review system

typically 25 high-tech facilities

Investment: approx. 10.000 Mio Euro

Operation/year: 1.000 Mio Euro



Decision by facility management

Longterm commitment
to mastering a grand challenge in

Energy-environment
Medicine
Transport
Communication-information

together with key experts from
universities, research labs, industry

I3

Open Access Research

Facility I

GENNESYS

Strategic Research

On Site

Science Centre „Nanomaterials for future energy“

European HUB

Research Training Strategy

Longterm commitment
to mastering a grand challenge in

Energy-environment
Medicine
Transport
Communication-information

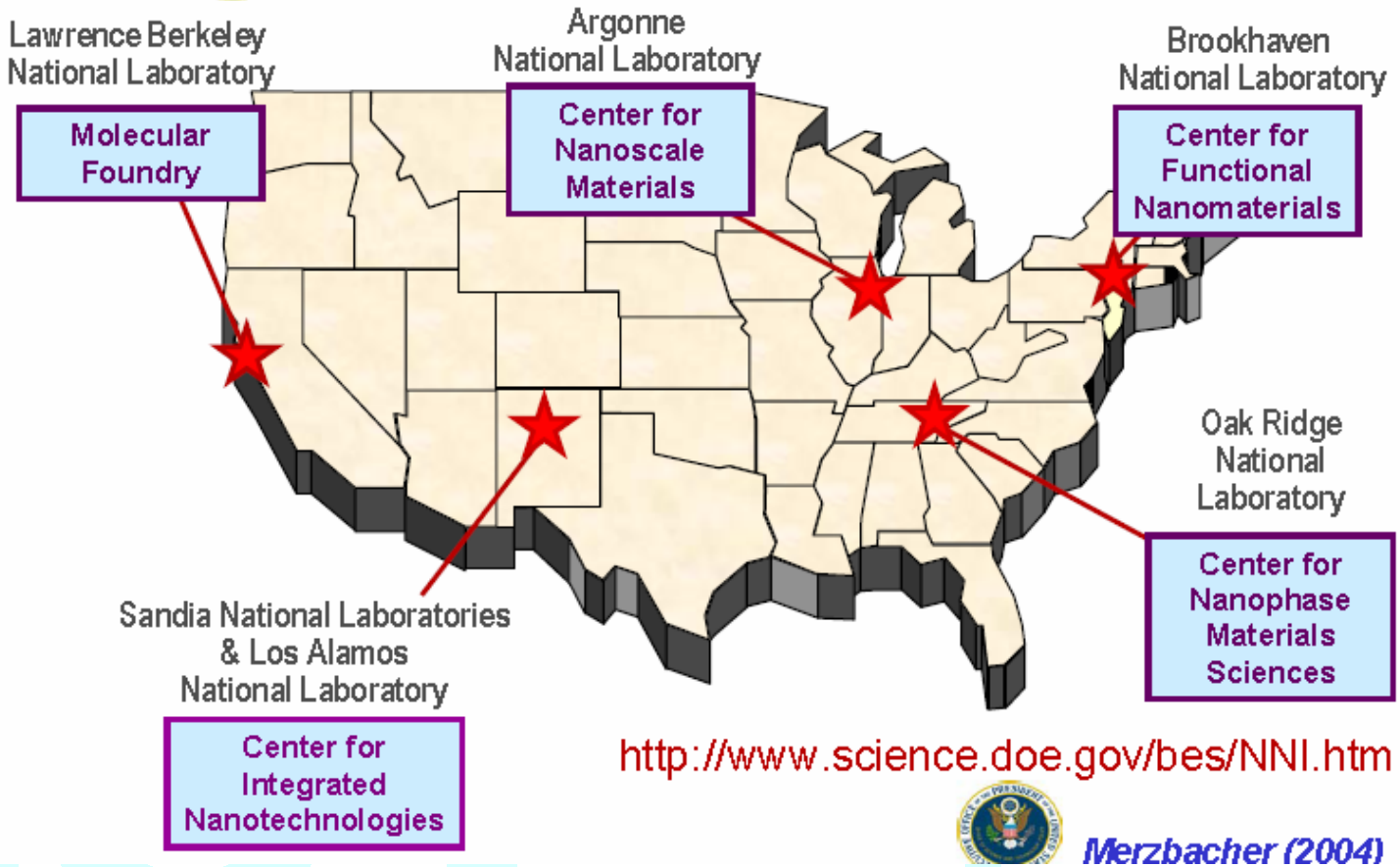
together with key experts from universities, research labs, industry

HELMHOLTZ GEMEINSCHAFT

DESY

Nanoscale Science Research Centers

DOE state-of-the-art facilities



http://www.science.doe.gov/bes/NNI.htm

Merzbacher (2004)

I3

Open Access Research

Facility I

GENNESYS

Strategic Research

On Site

Science Centre „Nanomaterials for future energy“

International Cooperations
US, Russia, Asia

European HUB
Research Training Strategy

estimate:
construction costs
100 Mio € /SC

Offshore Institutes

Computing

A new integration scheme for ERA in strategic research

potential for step-wise implementation

requires major political decision
European coordination

GENNESYS provides all necessary
roadmaps
priority list

Strategic Cooperation
Research & Training

Science Centre

Facility II

RIS
GENNESYS
Partners:
Synchrotrons
Neutrons
Lasers

HELMHOLTZ GEMEINSCHAFT

DESY

GENNESYS International Congress on Nanotechnology and Research Infrastructure

Barcelona
26-29 May, 2009 approx. 1000 participants

Promote -
- collaboration between materials science, universities, industry, RI
- creation of European centres of Excellence
- strategic relevance of RI (Grand Challenges)

TOPIC A 90min

Chairman Introduction	Chairman Panel (5)

Future Role of Synchrotron Radiation, Laser and Neutron facilities

C. Rizzuto (ESFRI) M. van der Rest	Hervé Pero (EC) 5 Lab Directors

Need for Sponsoring of Congress: 5-10 T€ / facility